



hp calculators

HP 39gs The MATH menu

Using the menu

The REAL functions

The TRIG functions

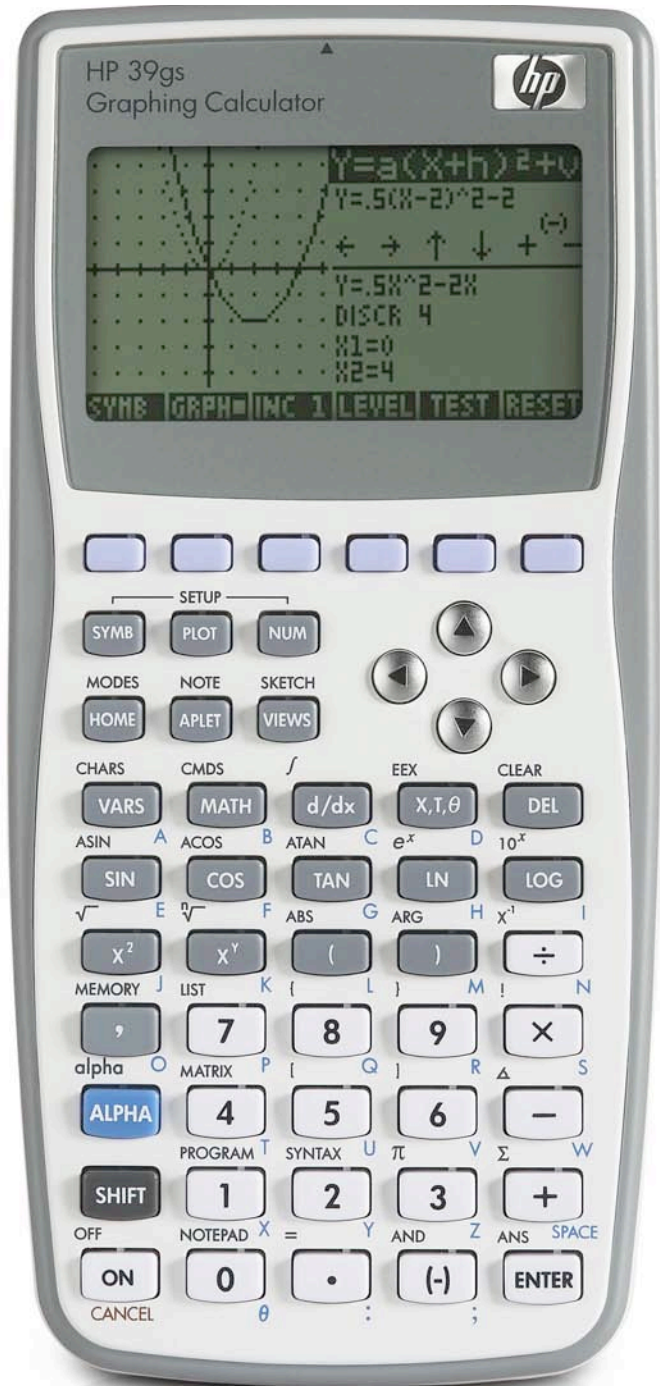
The LIST functions

The MATRIX functions

The POLYNOMIAL functions

The PROBABILITY functions

The COMPLEX functions



Using the menu

The mechanics of accessing the MATH menu is very simple. It is illustrated here using the function POLYFORM from the Polynomial group, covered in more detail later. Change into the HOME view and then press the MATH button. You will see the screen on the right. The menu appears first with the Real functions highlighted.

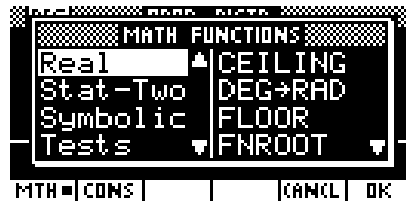


Figure 1

It is possible to use the arrow keys to scroll down to the Polynomial functions but it is far faster to simply press the key labeled with the letter 'P' (on the '7' key). It is not necessary to press the ALPHA key first. You will notice in the screen on the right that there are two groups of functions beginning with a 'P' - Polynomial and Probability. To reach Probability just press the 'P' key again or scroll down.

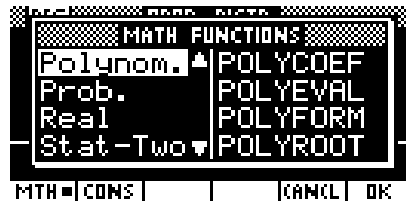


Figure 2

Once in the correct group, press the right arrow key to move into the list of functions belonging to that group. Once again you have a choice of using the arrow keys or the button corresponding to the first letter of the function. Pressing the right arrow key again will move down the functions a 'page' at a time. In this case, since every single function in the Polynomial group begins with a 'P', and there is only one 'page' of them, there is no difference between the methods. Move the highlight down to POLYFORM and then press the ENTER key.

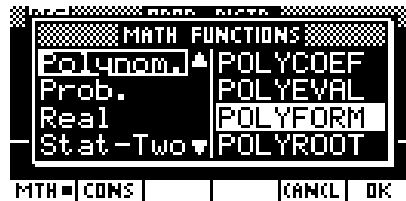


Figure 3

Your HOME view should now look like this...

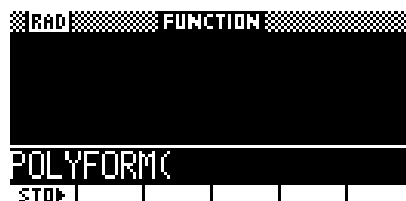


Figure 4

You will notice that the first bracket has already been inserted for you. This is the normal practice. Press ON to clear the edit line.

hp calculators

HP 39gs The Math menu

The REAL functions

These are the functions which deal with real numbers, rounding, exponents, conversions and so on. Some examples are given below but you should see the manual for the complete list.

DEG->RAD(degrees)

This function converts degrees to radians.

Eg. DEG->RAD(30) = 0.5235...
DEG->RAD(180) = 3.1415926...

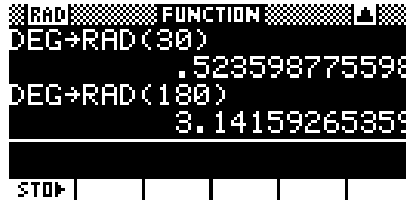


Figure 5

ROUND(num,dec.pts)

This function rounds to a number of decimal places.

Eg. Round 66.65 to 1 decimal place..
Use: ROUND(66.65,1)=66.7

Round 34.56784 to 2 decimal places.
Use: ROUND(34.56784,2)=34.57



Figure 6

This function is also capable of rounding off to a specified number of significant figures. To do this, simply put a negative sign on the number of places.

Eg. Round 32345 to the nearest thousand.
Use: ROUND(32345,-2) = 32000

Round 3405.63475 to 6 sig.fig.
Use: ROUND(3405.63475,-6) = 3405.63

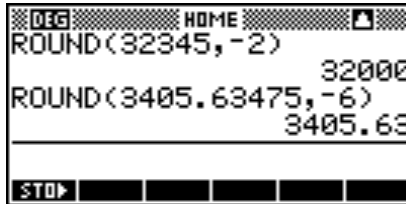


Figure 7

This function is also capable of rounding off to a specified number of significant figures. To do this, simply put a negative sign on the number of places.

The TRIG functions

This group, together with the associated Hyperbolic group of functions, covers the less commonly used trigonometry functions which were not put on the keyboard.

They are used in exactly the same way as the normal SIN, COS and TAN functions, together with their inverse functions of ASIN, ACOS and ATAN (which are all on the face of the calculator).



Figure 8

hp calculators

HP 39gs The Math menu

In the Trig. group of functions you will also find:

<u>Function</u>		<u>Inverse function</u>	
COT	(cotangent)	ACOT	(arc-cotangent)
CSC	(cosec/cosecant)	ACSC	(arc-cosec)
SEC	(secant)	ASEC	(arc-secant)
SINH	(hyperbolic sine)	ASINH	(arc-hyperbolic sine)
COSH	(hyperbolic cosine)	ACOSH	(arc-hyperbolic cosine)
TANH	(hyperbolic tangent)	ATANH	(arc-hyperbolic tangent)

The LIST functions

A list is the same as a set. It is separated by commas and enclosed with a pair of curly brackets. Eg. {2,5,-2,10,3.75}

The most useful of the functions in the List category is the MAKELIST function. This function produces a list of the length specified using a rule of your choice. Note: The STO> symbol indicates pressing the STO key.

The syntax is: MAKELIST(expression, variable, start, end, increment)

where	expression	is the mathematical rule used to generate the numbers.
	variable	is the variable used in the expression.
	start	is the first value that variable is be given.
	end	is the largest value that variable is to take.
and	increment	is the amount by which variable should be incremented.

Eg. 1 MAKELIST(X²,X,1,10,2) STO> L1
produces { 1, 9, 25, 49, 81 } as X goes from 1 to 3 to 5 to ...
and also stores the result into L1.

Eg. 2 MAKELIST(RANDOM,X,1,10,1) produces a set of 10 random numbers. The X in this case serves only as a counter.



Figure 9

Eg. 3 MAKELIST(3,X,1,10,2) produces the list {3,3,3,3,3,3,3,3,3,3}.

The MAKELIST function can also be used to simulate observations on random variables.

For example, suppose we wish to simulate 10 Bernoulli trials with $p = 0.75$. We can use the fact that a test like $(X < 4)$ or $(Y > 0.2)$ returns a value of either 1 (if the test is true) or 0 (if the test is false). Thus $\text{MAKELIST}(\text{RANDOM} < 0.75, X, 1, 10, 1)$ will return a list of 1's and 0's corresponding to the simulated Bernoulli trials.

Example 1: Simulate 100 observations on a continuous $U[10,15]$ distribution.

In HOME type: $\text{MAKELIST}(5 * \text{RANDOM} + 10, X, 1, 100, 1) \text{ STO} > \text{C2}$

Example 2: Simulate 50 observations on a discrete uniform random variable $U[3,7]$

In HOME type: $\text{MAKELIST}(\text{INT}(5 * \text{RANDOM} + 3), X, 1, 50, 1) \text{ STO} > \text{C2}$

hp calculators

HP 39gs The Math menu

Example 3: Simulate 50 observations on a Binomial random variable with $n=20$ & $p=0.75$.

In HOME type: `MAKELIST((I=1,20,RANDOM<0.75),X,1,50,1) C2`

Note: The `⌈` and the `=` are both on the keyboard. Each element of the 100 in the list will be the sum of 20 Bernoulli trials. This will be a relatively slow calculation because it involves evaluating 1000 random numbers (50×20).

Example 4: Simulate 100 observations on a normal distribution with Mean =80 and $\text{Sigma}^2=50$.

In HOME type: `MAKELIST(80+ 50*((-2*LN(RANDOM))*sin(2*RANDOM)),X,1,100,1) STO> C2`
(ensure MODES is set to Radian measure first)

The MATRIX functions

This very extensive group of functions is provided to deal with matrices. One of the most useful is the RREF function which is used to convert augmented matrices into reduced row echelon form.

The scope of functions and abilities covered in this group is vastly greater than would be required by the average school student or teacher. Consult the manual for details. Two small examples are given below.

DET(matrix)

This function finds the determinant of a square matrix.

Eg. If $A = \begin{bmatrix} 2 & 3 \\ -1 & 5 \end{bmatrix}$ then find $\det(A)$.

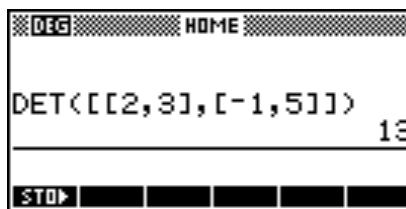


Figure 10

LQ(matrix)

This function takes an $m \times n$ matrix, factors it and returns a list containing three matrices which are (in order):

- an $m \times n$ lower trapezoidal matrix
- an $n \times n$ orthogonal matrix
- an $m \times m$ permutation matrix.

To separate these matrices for later use, store them into a list variable.

For example `LQ(M1) STO> L1` would store the three resulting matrices into list variable L1. In the HOME view you could now enter `L1(1) STO> M2` to store the first of the result matrices into M2 and so on.

The PROBABILITY functions

This group of functions manipulates probabilities and probability distribution functions.

RANDOM

This function supplies a random 12 digit number between zero and one. If you want a series of random numbers, just keep pressing ENTER after the first one.

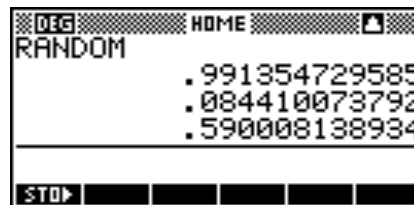


Figure 11

hp calculators

HP 39gs The Math menu

Eg. Produce a set of random integers between 5 and 15 inclusive.

Use the expression $\text{INT}(\text{RANDOM} \times 11) + 5$

The $\text{RANDOM} \times 11$ produces a range from 0 to 10.999999. This is then dropped down to the integer below by the INT function, giving a range of integers 0,1,2,3,...,10. The final adding of 5 gives the correct range.



Figure 12

Tip: If you enter RANDOM on two calculators taken straight from their boxes the results will be the same “random” set! To stop this happening you need to seed the internal algorithm with a different value on each calculator. The simplest way to do this is to type $\text{RANDSEED}(\text{Time})$ in the HOME view. Since the internal clock will have a different time for each calculator this will mean that everyone will get different values. This will need to be re-done if you reset the calculator.

COMB(n,r)

This function gives the value of ${}^n C_r$.

Eg. Find the probability of choosing 2 men and 3 women for a committee of 5 people from a pool of 6 men and 5 women.

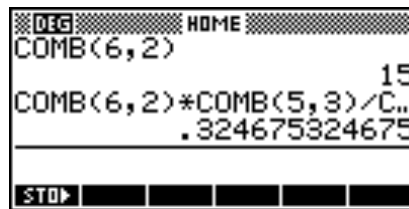


Figure 13

Tip: The reason for the single ‘COMB(6,2)’ above the main calculation is to save time. Rather than using the MATH menu for every entry of the COMB function, you can enter it once and then use it repeatedly, changing the parameters.

UTPN(mean, variance, value)

This function, the ‘Upper-Tail Normal Probability’, gives the probability that a normal random variable is greater than or equal to the value supplied. Note that the variance must be supplied, NOT the standard deviation.

Eg. Find the probability that a randomly chosen individual is more than 2 meters tall if the population has a mean height of 1.87m and a standard deviation of 10.4cm

$$\bar{x} = 1.87m, \sigma = 0.104m$$

$$\Rightarrow \sigma^2 = 0.010816$$

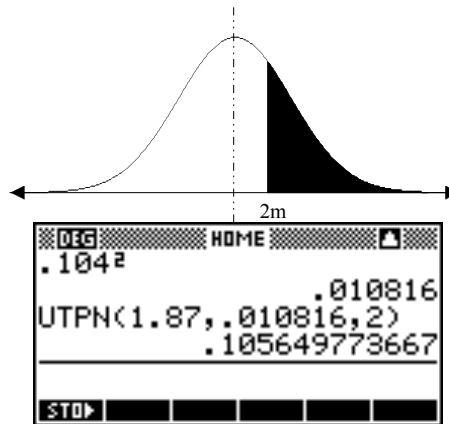


Figure 14

As shown right, $\text{Pr}(\text{height} > 2m) = 0.1056$, or 10.56%.

The POLYNOMIAL functions

These functions are all ones which you will use regularly. Some are outlined below.

POLYCOEF([root1, root2, ...])

Returns the coefficients of a polynomial with roots x_1, x_2, x_3, \dots . The roots must be supplied in vector form, which for the hp39gs means putting them in square brackets.

hp calculators

HP 39gs The Math menu

The function $f(x)$ above has roots 2, -3 and 1. The screen shot to the right shows the POLYCOEF function giving the required coefficients as 1, 0, -7 and 6 for a final polynomial of $f(x) = x^3 - 7x + 6$.



Figure 15

POLYFORM(expression, variable, name)

This is a very powerful polynomial function. It allows algebraic manipulation and expansion of an expression into a polynomial. The expected parameters for the function are firstly the expression to be expanded, and secondly the variable which is to be the subject. If the expression contains more than one variable then any others are treated as constants.

Eg. 1 Expand $(2x - 3)^3(x - 1)^2$
 Result: $8x^5 - 52x^4 + 134x^3 - 171x^2 + 108x - 27$

The resulting polynomial is shown both as it appears in the HOME view and as it appears after pressing the SHOW key

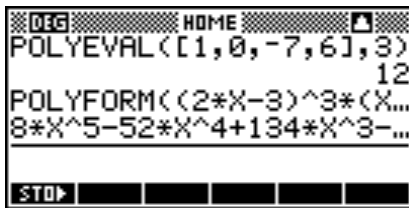


Figure 16

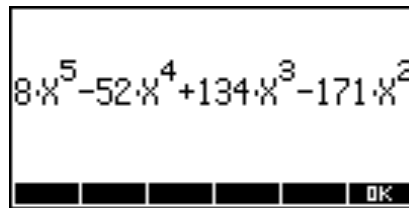


Figure 17

The resulting polynomial is shown both as it appears in the HOME view and as it appears after pressing the SHOW key

Eg. 2 Expand $(3a - 2b)^4$

This function contains two variables, A and B, which must be expanded separately. The first expansion, treating A as the variable, is POLYFORM((3A-2B)^4,A).



Figure 18

Pressing SHOW, it can be seen that the expansion of the expression in terms of A has been done, but the terms involving B are not fully evaluated.

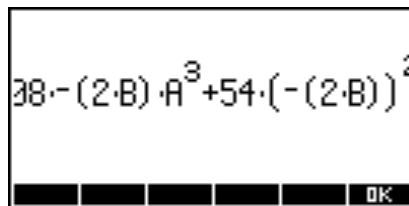


Figure 19

hp calculators

HP 39gs The Math menu

The solution is to use POLYFORM again. Use the MATH menu to fetch the POLYFORM function to the edit line, then move the cursor up to the partially evaluated expression that was the result of the previous POLYFORM. Copy it into the edit line, add a comma, a B and an end bracket. Pressing ENTER will now evaluate the terms involving B.

After pressing ENTER for the second evaluation, the result is shown right (after pressing SHOW).

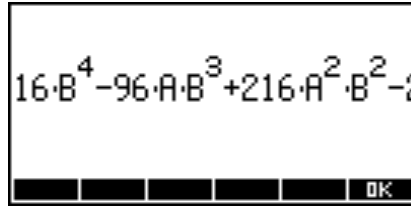


Figure 20

The COMPLEX functions

Complex numbers on the hp 39gs can be entered as they are commonly written in mathematical workings as a + bi with the i obtained using SHIFT ALPHA to get lowercase, or as an ordered pair (a,b). As soon as you press ENTER, the calculator immediately converts the a + bi form into an ordered pair.

The exception is when a complex number is entered in rcis form using the \angle sign on the keyboard. See the edit line to the right to see how it was entered with the results shown above. When you do this the calculator converts to a more explicit rcis format as shown right, and gives the result as an ordered pair. This behavior only happens in Radian mode.

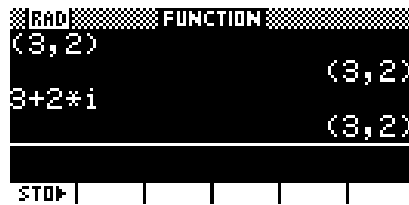


Figure 21



Figure 22

Complex numbers can be used with all trigonometric and hyperbolic function, as well as with matrices, lists and some real-number and keyboard functions. There are 10 special memories (Z1,Z2..Z9,Z0) which are provided to store complex numbers.

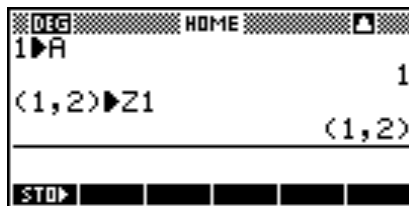


Figure 23

ABS(real or complex) - found on the keyboard and the MATH menu

The absolute function returns the absolute value of a real number.

When you use ABS on a complex number a + bi, it returns the magnitude of the complex number $\sqrt{a^2 + b^2}$.

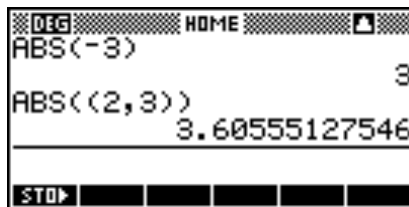


Figure 24

hp calculators

HP 39gs The Math menu

SIGN(real or complex)

This function is part of the Real group but is more useful with complex numbers. Given a vector/complex number (a,b), SIGN will return another vector/complex number which is a unit vector in the direction of (a, b).

i.e. $SIGN((A,B))$ returns $\left(\frac{a}{\sqrt{a^2+b^2}}, \frac{b}{\sqrt{a^2+b^2}}\right)$.

ARG(complex or vector) - on the keyboard and the MATH menu

This function returns the argument of the complex number. For example, as shown right, $ARG(4+2i)$ would be approximately 26.565.

The reason for the double brackets in the screen shot right is that every function used by the calculator uses brackets (hence the outer pair) but so too do complex numbers (hence the inner pair). Using $ARG(a+bi)$ avoids this.

IM(complex) and RE(complex)

These functions return the imaginary and real parts of the complex number supplied. If you enter $a + bi$ then $IM((a,b)) = b$ and $RE((a,b)) = a$.

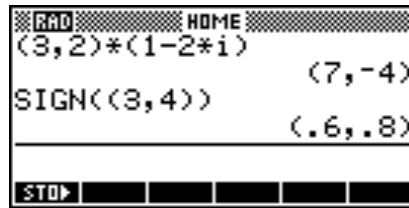


Figure 25

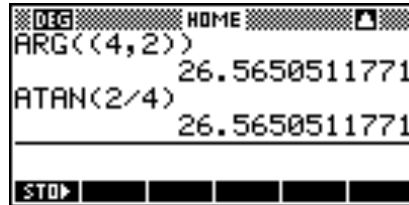


Figure 26



Figure 27